in a chapter, but it might not be so obvious in the uncategorized real world or even on a final exam or MCAT. Determine the subgrouping of ideas to which the problem most clearly belongs, such as average speed, instantaneous speed, displacement, and so on. Look for key ideas and phrases that distinguish one group of notions from another, such as references to direction. These indications tell you that you are dealing with displacement or velocity. Watch for expressions like *straight road, steady motion, constant speed*, and so forth—they provide vital information.

3. Draw sketches that illustrate the problem being analyzed. Put into these all the known information and, where appropriate, draw in the vectors to represent directional quantities.

4. For most simple single-concept problems there will be one unknown that can be determined from one formula. Write down the equation that contains the desired unknown (and only that one unknown) and solve for it algebraically in terms of the remaining knowns. Problems involving two unknowns require solving two equations simultaneously {see **MATH REVIEW: PART A-4** on the **CD** for a geometry review }. Remember you will need the same number of equations as there are unknowns to be found.

5. **Unless otherwise required, work all problems in SI units.** Convert the given numerical information into appropriate units *before* substituting into equations. It's best to convert as soon as possible to avoid accidentally using the wrong values (10 cm is *not* 10 m). Carry the units for each term through the whole calculation as a double check that you haven't messed up the algebra: an answer of 10 km/h for how *far* the chicken traveled suggests something is amiss; an answer of just 10 tells you a good deal less and is incomplete. Always include units with your numerical answers.

6. Always try to check your answers by recomputing the problem in a different way.

7. Watch out for the number of significant figures. If you travel 10.2 m (three significant figures) in 2.1 s (two significant figures), your average speed is 4.9 m/s (two significant figures) and *not* 4.857 142 9 m/s.

8. To foster some independence from the calculator, a number of problems are given with "nice" numbers so they are easier to do by hand than by machine. Avoid using the calculator to divide 100 by 2, wondering all the while why you bothered. Some important national examinations do not allow calculators to be used.You should know what the curves of the sine, cosine, and tangent functions look like. Also know their values for 0°, 30°, 45°, 60°, and 90°. Become familiar with the 3-4-5 and 5-12-13 right triangles.

Problems + Coordinated Problems + Progressive Problems + Solutions

STUDY GUIDE **1. Coordinated Problems:** The three problems within each magenta-colored grouping are solvable in similar ways. Note that the first of these always has a hint; moreover, its solution is provided in the back of the book. *Work out each of these sets; they'll strengthen technique and build confidence.* **2. Progressive Problems:** The problems introduced in blue unfold step-by-step carrying along the analysis in a more suggestive way than is customary. *Work out all of these; they'll guide you through the analytic process and help develop problem-solving skills.* **3. Worked-Out Solutions:** Studying worked-out solutions is an important part of learning how to solve problems. Accordingly, additional ***solutions*** to a number of model problems are given below. *Make sure you understand each of them before you go on to the next problem.* **4.** Also provided in the back of the book are the ***Answers*** to all odd-numbered problems, as well as worked-out ***solutions*** to those with boldface numbers. Problem numbers in italic indicate that a solution appears in the Student Solutions Manual.

SECTION 2.1: AVERAGE SPEED

1. [I] THIS PROBLEM WILL HELP US BETTER UNDERSTAND AVERAGE SPEED. During a trip to the supermarket a car covers 5.0 km in 0.25 h. (a) What's the total distance traveled in meters? (b) What's the total time in seconds that it took to travel that distance? (c) What's the car's average speed? Give your answer in m/s.

2. [I] THIS PROBLEM WILL HELP US BETTER UNDERSTAND AVERAGE SPEED. A kid on a bike traveled 500 m around a circular track in 20 min. (a) What was the total distance traveled in meters? (b) What was the total time in seconds that it took to travel that distance? (c) How fast, on average, was she moving? Give your answer in m/s.

3. [I] In the next 30.0 s, the Earth will travel roughly 885 km (i.e., 550 mi) along its orbit around the Sun. Compute its average orbital speed in km/s. Draw a diagram. [*Hint: Average speed is defined by Eq. (2.1).*]

4. [I] A baseball is thrown and in 2.0 s its shadow on the ground travels 180 m in a straight line. What's the average speed of the shadow? Is that more, less, or the same as the average speed of the ball? Draw a diagram.

5. [I] Standing on the roof of a building, a kid drops a plastic bag filled with water at a height of 100 m, and 4.5 s later it strikes the ground. Determine the bag's average speed.

6. [I] Hair grows at an average rate of 3×10^{-9} m/s. How long will it take to grow a 10-cm strand?

SOLUTION: The speed at which a hair grows is 3×10^{-9} m/s. The time it takes for the end to travel 10 cm = 0.10 m is

$$t = \frac{l}{v_{av}} = \frac{0.10\ \text{m}}{3 \times 10^{-9}\ \text{m/s}} = 3 \times 10^{7}\ \text{s}$$

7. [I] Given that a glacier creeps along at an average speed of 1×10^{-6} m/s, how long will it take to advance 1.0 km?

8.[I] How long does it take the sound of thunder to go 1.000 mile (1.609 km) traveling at an average speed of $3.314\ 5 \times 10^{2}$ m/s?

9. [I] Referring to Table 2.3 (p. 24), derive each conversion factor in the first column.

10. [I] Referring to Table 2.3 (p. 24), derive each conversion factor in the second column.

11. [I] If the odometer in a car at the beginning of a trip read 12723.10 km and 2.00 h later it read 12 973.10 km, what was the average speed during the journey?

SOLUTION: Δl = 12 973.10 km − 12 723.10 km = 250 km, hence $v_{av} = \Delta l/\Delta t$ = (250 km)/(2.00 h) = 125 km/h.

12. [I] Having traveled 900 km in 9.00 h, how fast should a driver go if he is to finish the entire 1000-km journey at an average speed of 100 km/h?

13. [I] A 30-km trip is negotiated in two equal-length segments. The first, on highways taking 15 min; the second, through heavy traffic and taking 45 min. Compute (a) the average speed along each leg and (b) the average speed over the whole trip. Draw a diagram.

14. [I] The SR-71 strategic reconnaissance aircraft, the *Blackbird*, set a world speed record by flying from London to Los Angeles, a distance of 8790 km (5463 mi), in 3 h 47 min 36 s. (a) Compute its average speed in m/s. (b) It recaptured the 1000-km closed-circuit-course record (previously held by the Russian MIG-25 *Foxbat*)